SANTA CLARA VALLEY WATER DISTRICT

CALABAZAS CREEK PLANNING STUDY

Miller Avenue to Comer Drive

Staff Recommended Alternative Report

Project No. 26104001

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A. PURPOSE OF REPORT

The purpose of this report is to describe feasible flood protection alternatives and to rate them using the District's Natural Flood Protection Evaluation Guidelines as criteria to identify a staff recommended flood protection project for the Calabazas Creek (see Figure A-1 Watershed Map on page 6). This report also describes the staff recommended erosion repair work and methods, as well as channel ecological restoration opportunities.

B. SUMMARY OF PROJECT

Recurrent flooding and erosion along Calabazas Creek presents a long–term hazard to public safety, property values, and the economy in the Cities of Cupertino, San Jose, and Saratoga. Hydraulic models identify four locations where flood flows overtop channel banks during the 1% storm (1 event an average of every 100 years) as shown in Figure B-1. The four flooding areas are located at:

Site #1: Calabazas Park (between Rainbow Drive and Blaney Avenue)
Site #2: A residential area downstream of HWY 85
Site #3: A business parking lot upstream of Saratoga-Sunnyvale Road
Site #4: Another residential area upstream of the Union Pacific Railroad (UPRR).

Historically, the soffits of the foot bridge at site #2, the Prospect to Saratoga-Sunnyvale Road tunnel downstream of site #3, and the UPRR bridge downstream of site #4 all have been submerged during the 1% flood. The District 1% flood limit is shown on Figure B-2 on page 8.

Erosion sites along the creek bank jeopardizes residential and public lands adjacent to the creek (see Figure C-1 on page 9). Of the 84 erosion sites identified, 25 have been classified as major erosion sites which are recommended to be repaired as a part of this project (see Appendix G). See the Problem Definition / Refined Objectives Report[1] for more details.

Three channel enhancement opportunities are identified and recommended as part of the project as follows:

- Comer Debris Basin Geomorphic Design Modification
- Revegetation Enhancement (downstream of Prospect Road)
- Calabazas Park Meander Restoration

The Comer Debris Basin enhancement includes the replacement of the Comer Dam with a series of channel invert stabilizers as described on page 35 (Alternative 2). The Revegetation Enhancement includes revegetation of 3800 feet of creek bank as described on page 37. The Calabazas Park Meander Restoration includes restoration of an abandoned creek bed in Calabazas Park as described on page 38.

C. OBJECTIVES OF PROJECT

As part of the Clean, Safe Creeks and Natural Flood Protection Program (projects funded by the 2000 voter-approved Measure B), the Santa Clara Valley Water District (District) initiated the Calabazas Creek Planning Study to provide flood protection, erosion control and channel restoration from Miller Avenue to Wardell Road.

The project objectives are directly tied to the Problem Definition Report[1] and represent the targeted/desired future conditions for the project area. The project objectives provide the fundamental building blocks for identifying, developing, and evaluating the project alternatives. The objectives of the Planning Study are as follows:

- Develop a plan for the entire watershed that presents alternatives and a recommendation for providing flood protection for all flows up to the one-percent flood, erosion protection, and creek restoration for Calabazas Creek and its tributaries (Regnart and Rodeo Creek) between Miller Avenue and Comer Drive by 10/30/2007.

- Provide flood protection to 2,483 homes, businesses and schools upstream of Miller Avenue (Bollinger Road bridge will be re-built in 2007-2008 under a separate project) from a one-percent (100-year) flood, preventing potential damages of $30.9 million[2] by 12/31/2012.

- Identify opportunities for environmental enhancement such as stream restoration, as well as trails, parks, and open space, for the Board’s consideration by 10/30/2007.

- Minimize the cost of maintenance.

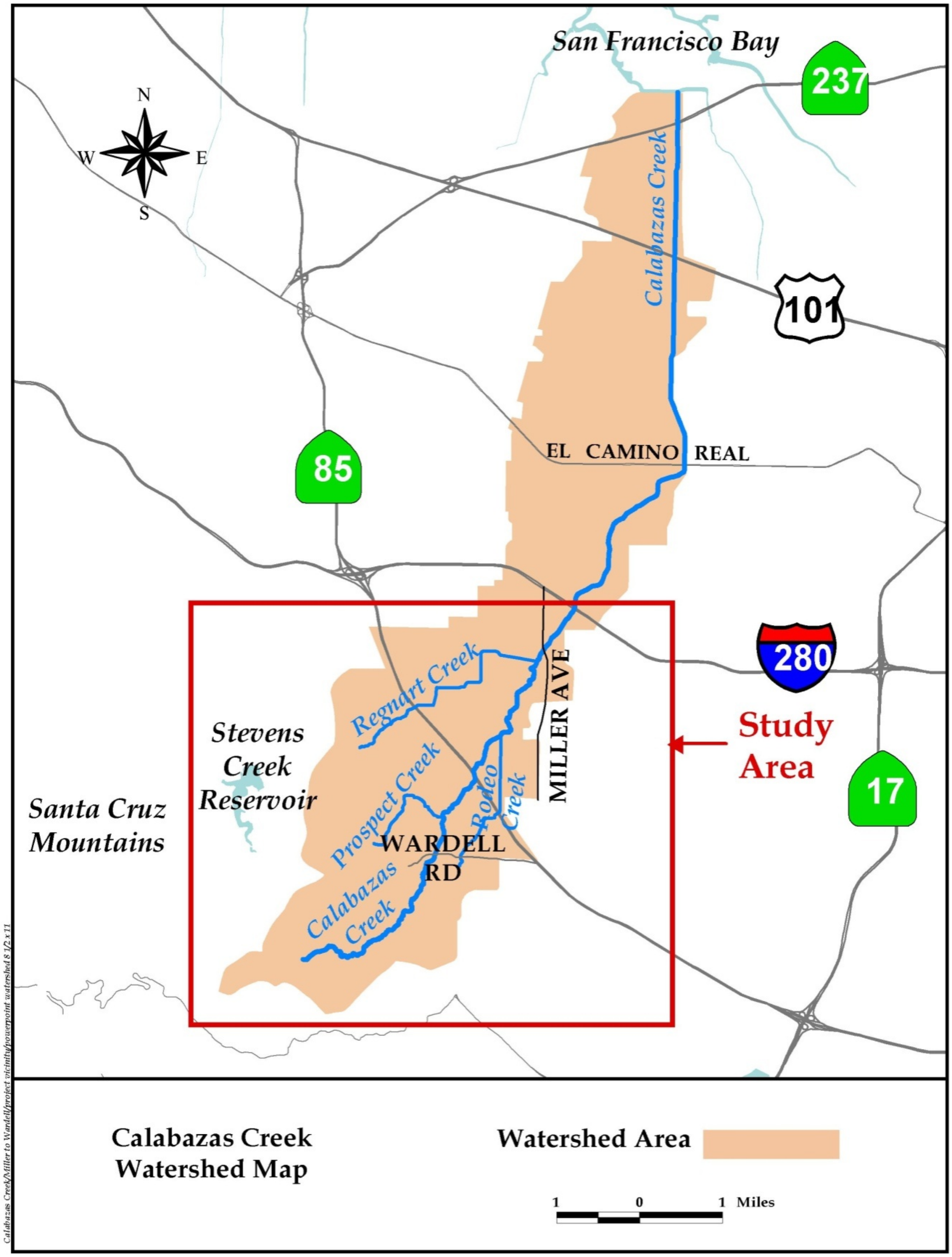

Figure A-1: Watershed Map

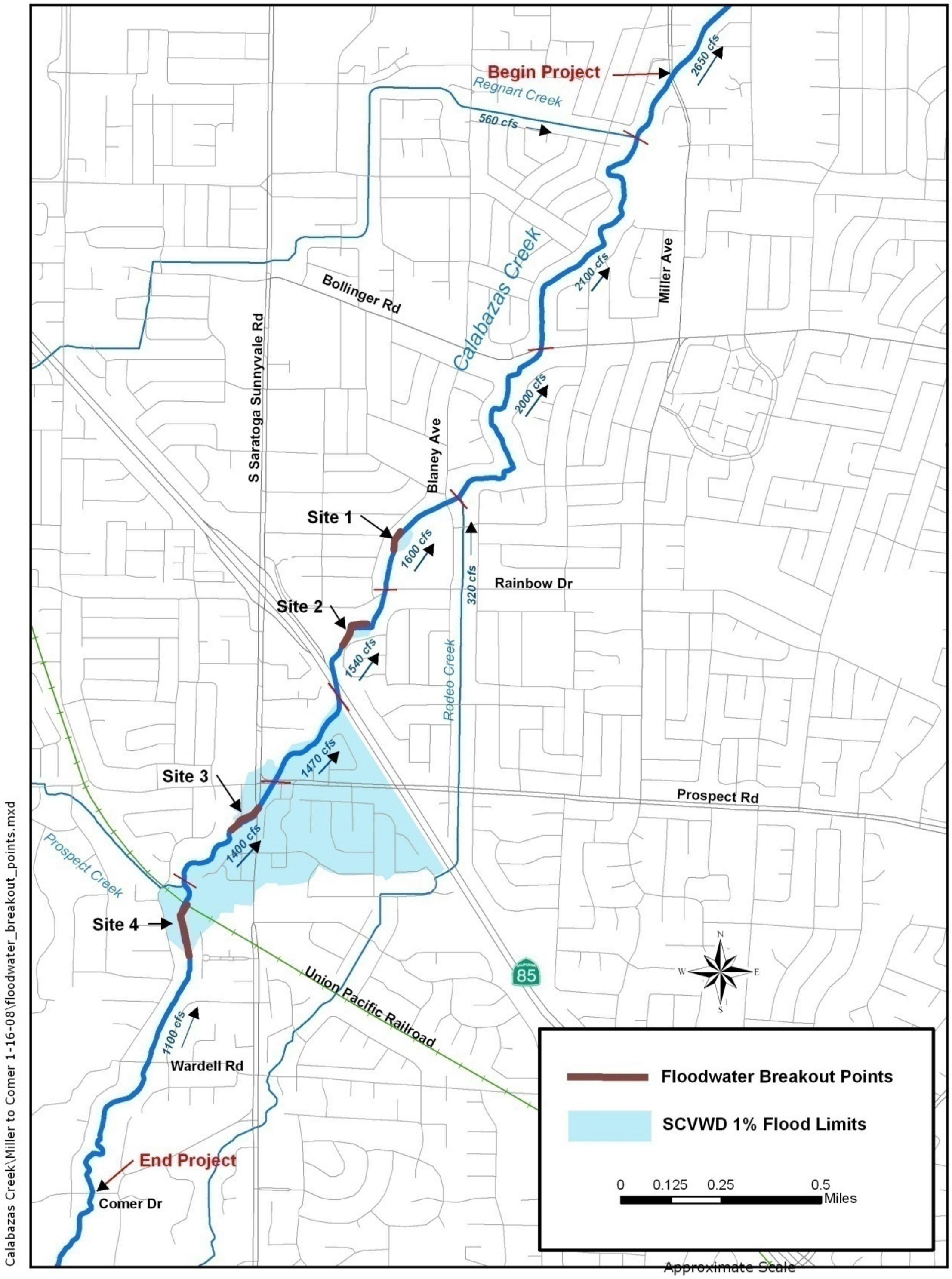

Figure B-1: Original four Flood Protection Sites

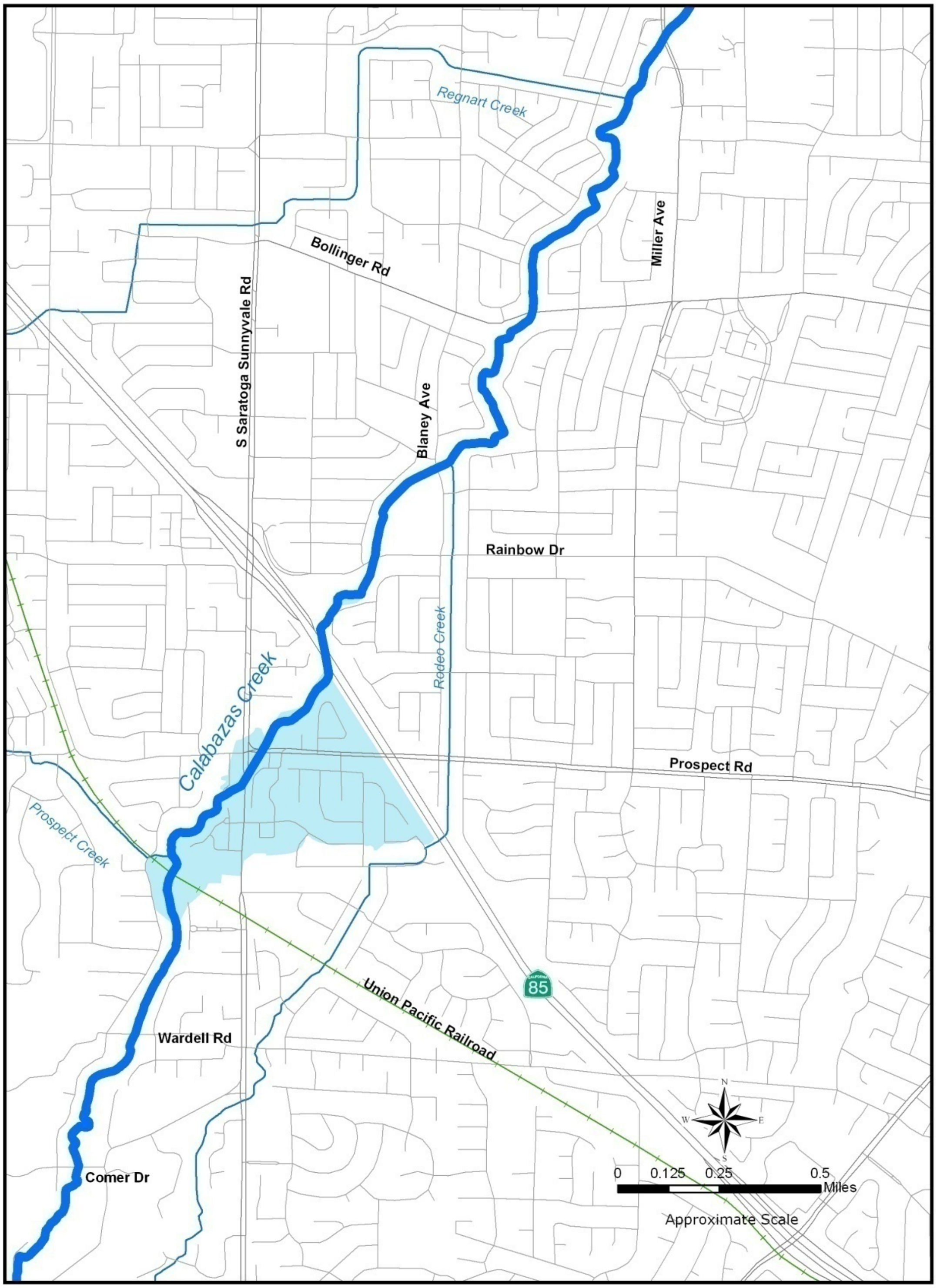

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Figure B-2: District 1% Flood Limit

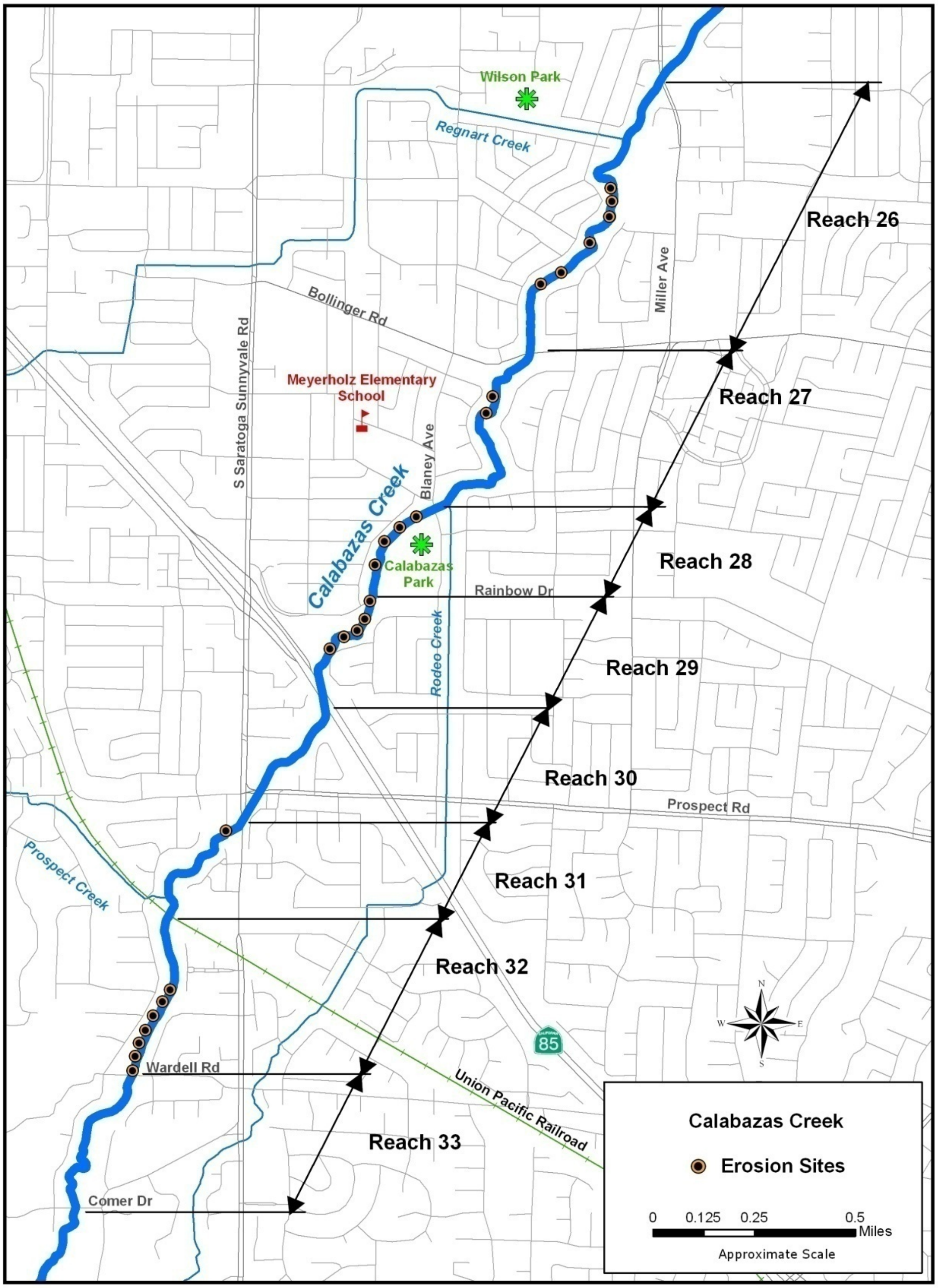

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Figure C-1: Major Erosion Sites Map

D. DESCRIPTION OF FLOOD PROTECTION ALTERNATIVES

The Problem Definition / Refined Objects Report[1] identified four different flooding sites (see Figure B-1 on page 6). The Conceptual Alternatives Report completed in 2006 presented Project Alternatives using various combinations of 13 different project alternatives. Many of these alternatives have been eliminated.

The City of San Jose began construction of a BMX Park adjacent to Calabazas Creek at Site #1 in December, 2006 and finished this work in spring of 2007. Grading required to build the BMX Park raised the adjacent Calabazas Creek banks high enough to eliminate flooding at Site #1.

Flooding at Site #2 doesn't flood developed property, with the exception of one private swimming pool. A City building permit was submitted for the pool construction on June 4, 1963. About 2 days later, the Cupertino Creekside Condominiums granted the District easements within the vicinity on June 6, 1963. The City provided the final pool building permit inspection on August 20, 1964. The pool was built without the required District permit. Site #2 has also been removed from further study because of the low financial impacts associated with the flooding of this pool.

Project Alternatives 1A, 1B, 1C, 2A and 2B (see Table D-1) are eliminated from further consideration for project flood protection improvements because they were associated with project alternatives at sites #1 and #2. Nonstructural or Flood Proofing Alternative was eliminated based on costs. The "No Project" alternative was also eliminated because it does not adequately address the community needs for flood protection and erosion protection. See Appendix E (Project Alternatives Description) for more details. This process left Sites #3 and #4 to be addressed in the project.

The flooding at Site #3 and Site #4 are independent from each other. In other words, flood protection work at Site #3 will have no influence over the flow rate, water surface elevation or flooding at Site #4. The eight project alternatives (E's) that remain at these two sites were evaluated further to create a staff recommended project alternative that will provide flood protection at Sites #3 and #4 (see Table D-1). See Figure D-1 for a plan view of site 3 and Figure D-2 a plan view of site 4.

The descriptions of feasible alternatives for each site are as follow: (see Appendix E for more details)

SITE	FLOODING LOCATION	PROJECT ALTERNATIVES
#1	Calabazas Park	**(ALT 1A)** Floodwall **(ALT 1B)** Channel Widening **(ALT 1C)** BMX Park Grade elevation ALT 1A, ALT 1B and ALT 1C are no longer discussed since Site #1 is eliminated.
#2	Foot Bridge	**(ALT 2A)** Raise existing Foot Bridge and Floodwall **(ALT 2B)** Relocate existing Foot Bridge and Floodwall ALT 2A and ALT 2B are no longer discussed since Site #2 is eliminated.
#3	Prospect to Saratoga-Sunnyvale Tunnel	**(ALT 3A)** Underground Reinforced Concrete Box (RCB) Bypass
		(ALT 3B) Additional Reinforced Concrete Box (RCB) or New Double RCB
		(ALT 3C) Floodwall
		(ALT 3D) Swale Detention Basin
		(ALT 3E) Swale Detention and Tunnel Modification
#4	UPRR	**(ALT 4A)** Underground Reinforced Concrete Pipe (RCP) Bypass
		(ALT 4B) Bridge Replacement
		(ALT 4C) Floodwall

Table D-1: Summary of Feasible Alternatives

Site 3: Prospect Road to Saratoga-Sunnyvale Road Tunnel

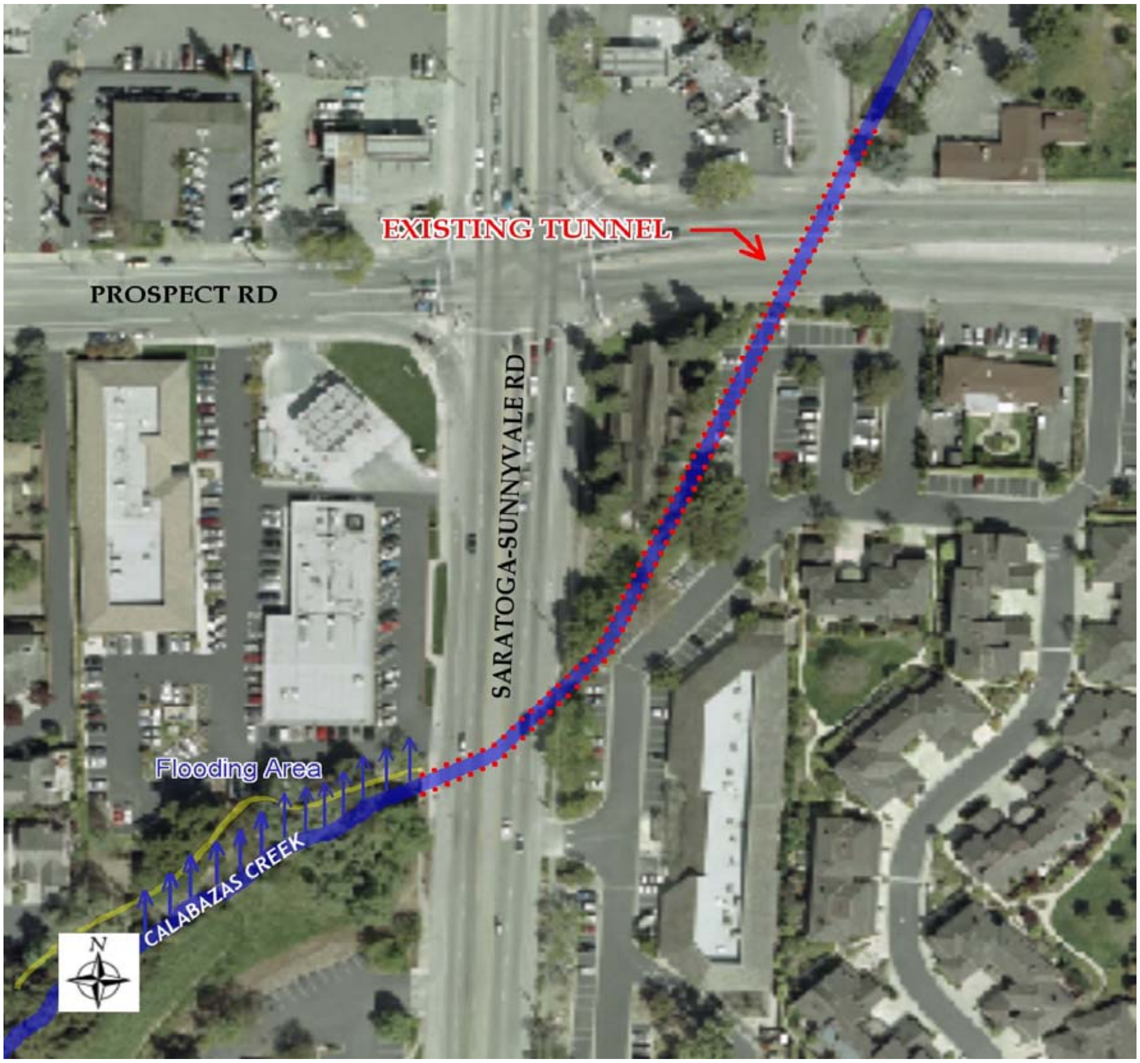


Figure D-1: Site 3 Flooding Area

At Site 3, floodwaters during the 100-year storm event would leave the creek on the north bank and flow into Saratoga-Sunnyvale Road.

ALT 3A: Underground RCB Bypass

Description

A 9-foot by 14-foot underground Reinforced Concrete Box (RCB) bypass (approx. STA 525+11 to STA 531+94) would be constructed with a different alignment along the existing tunnel from Prospect Road to Saratoga-Sunnyvale Road under the San Jose National Bank (SJNB) parking lot with a length of approximately 755 feet and capacity of half of the 1% design flow.

To prevent flooding upstream of the tunnel (Saratoga-Sunnyvale Road) during high flow events, an underground RCB bypass would be constructed along the existing tunnel under the SJNB parking lot on the west side. The proposed RCB would route excess flows around the problem area into the channel further downstream. See Appendix E (Flood Protection - Project Alternatives Description) for more details.

Operation and Maintenance

Operation and maintenance of the underground RCB bypass would be minimal. Although the RCB would be designed with adequate slope to move debris, the RCB upstream entrance would require regular cleaning to remove leaves and other debris during the low flow season.

Costs

Capital cost for this alternative would be approximately $4.6 million.

Annual maintenance cost for debris clearing from the RCB upstream entrance would be approximately $5,500.

See Appendix C for cost details.

ALT 3B: Additional RCB / New Double RCB

Description

The Additional Reinforced Concrete Box (RCB) is an underground 9-foot by 14-foot RCB that would be constructed parallel to the left side (looking upstream) of the existing underground concrete tunnel, between from Prospect Road and Saratoga-Sunnyvale Road (STA 525+11 to STA 531+94). The length is approximately 685 feet. A new double RCB would be a second option, replacing the existing tunnel with a new 9-foot by 14-foot underground concrete double RCB.

To prevent flooding upstream of the tunnel (Saratoga-Sunnyvale Road upstream face) during high flow events, one of these two options would be implemented. See Appendix E (Flood Protection - Project Alternatives Description) for more details.

Operation and Maintenance

Operation and maintenance of the additional RCB would be minimal. Although the additional RCB or new double RCB would be designed with adequate slope to move sediment, the upstream entrance would require regular cleaning to remove leaves and other debris during the low flow season.

Costs

Capital cost for this alternative would be approximately $4.0 million for the additional RCB or $5.2 million for a new double RCB.

Annual maintenance cost for debris clearing from inlet would be approximately $5,500

See Appendix C for costs details.

ALT 3C: Floodwall

Description

Upstream of Saratoga-Sunnyvale Road, a floodwall of up to 6 feet in height would be constructed along the top of the west bank along 400-450 feet of channel. The Saratoga-Sunnyvale existing tunnel would remain the same. Pressure flow resulting from ponding at the upstream end would convey the 1% flows. See Appendix E (Flood Protection - Project Alternatives Description) for more details.

Operation and Maintenance

Existing O&M activities are expected to continue within the project limits. Typical maintenance activities include trash and debris removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal. These maintenance activities would remain the same, and some additional maintenance activities would be required for graffiti removal.

Costs

Capital cost for this alternative would be approximately $0.4 million.

Annual maintenance costs for trash and debris removal, vegetation (overgrowth) removal and graffiti control would be approximately $9,500.

See Appendix C for costs details.

ALT 3D: Swale Detention Basin

Description

A large swale approximately 1350 feet long and 65 feet wide runs parallel to Calabazas Creek from Saratoga-Sunnyvale Road to downstream of the UPRR (STA 533+00.9 to STA 546+17.7) on the east side of the creek.

The existing swale would be converted to a detention basin to reduce downstream flow. This detention basin would store the peak flows during a flood and release them after the peak has passed. This off-stream detention would prevent flood inundation of the Prospect and Saratoga-Sunnyvale Road intersection, businesses and residential areas upstream and southwest of Saratoga-Sunnyvale Road.

This detention basin would require the construction of three structural weirs, a drainage pipe and a floodwall for a short distance at downstream end of the swale. See Appendix E (Flood Protection - Project Alternatives Description) for more details.

Operation and Maintenance

The swale detention basin would need regular maintenance for its inlet / outlet works. The detention basin itself would need minimal maintenance such as periodic vegetation and sediment removal. Existing O&M activities around the swale area are expected to continue. Typical maintenance activities include trash and debris removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal. Some additional maintenance activities would be required for floodwalls at downstream end of swale for graffiti removal.

Costs

Capital cost for this alternative would be approximately $0.8 million.

Annual maintenance cost for trash and debris removal, vegetation (overgrowth) removal & graffiti control would be approximately $5,500.

See Appendix C for costs details.

ALT 3E: Swale Detention and Tunnel Modification

Description

This alternative includes the installation of a 170-foot long overflow weir (STA 543+63 to STA 545+32) on the left bank (looking upstream) of the Calabazas Creek to divert flood water into the upstream end of the existing swale. A 1-foot diameter drainage pipe would be installed to return flows back into the creek at the downstream end of the existing swale.

This alternative also includes the replacement of 80 feet of the existing Saratoga/Sunnyvale concrete tunnel entrance section to improve flow efficiency and reduce upstream water surface elevations.

The new, enlarged reinforced concrete box (RCB) section would be 10-foot high and 16-foot wide. This new section (from STA 531+22 to STA 531+94) would be constructed along the same alignment as the existing tunnel under Saratoga-Sunnyvale Road. An 8-foot long transition (from STA 531+14 to STA 531+22) would connect the new (enlarged) RCB to the existing 9-foot by 12-foot tunnel. See Appendix E (Flood Protection - Project Alternatives Description) for more details.

Operation and Maintenance

Operation and maintenance of the swale component of this alternative would be minimal. The overflow weir would require periodic cleaning to remove leaves and other debris. The swale detention basin would need regular maintenance for its outlet pipe. Existing O&M activities around the swale area are expected to continue within the project limits. Typical existing maintenance activities include trash and debris removal, vegetation (overgrowth) removal, erosion repair in natural sections, and sediment removal.

Operation and maintenance of the new tunnel component of this alternative would be minimal.

Costs

Capital cost for this alternative would be approximately $1.0 million.

Annual maintenance cost for debris clearing from inlet, trash and debris removal and vegetation (overgrowth) removal would be approximately $9,000.

See Appendix C for costs details.

Site 4: Union Pacific Railroad (UPRR) bridge

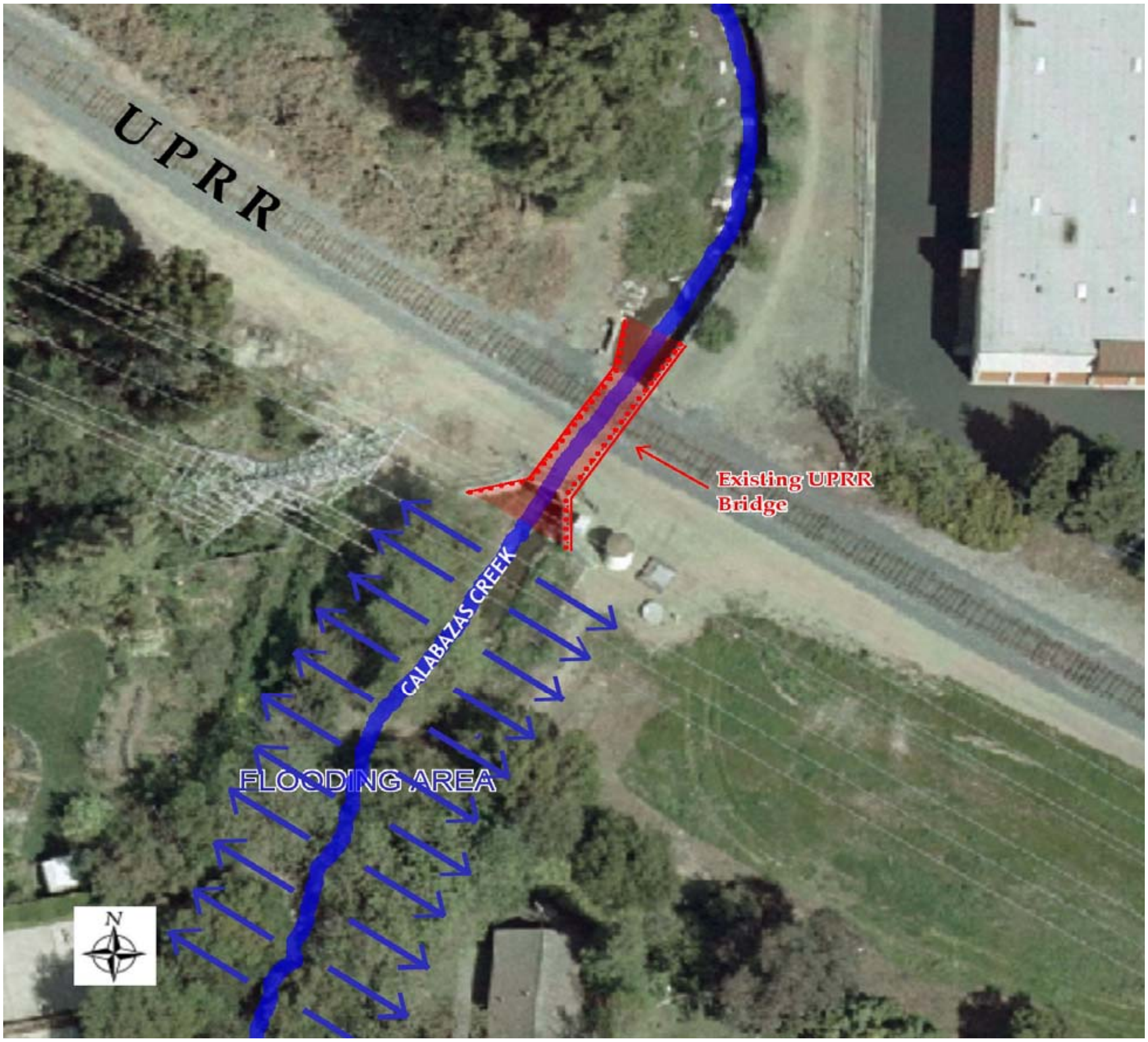


Figure D-2: Site 4 Flooding Area

At Site 4, floodwaters during the 100 year flood would leave the creek on both banks and flood the adjacent neighborhood located southwest of the UPRR.

ALT 4A: Underground RCP Bypass

Description

An underground bypass would be constructed consisting of an 84” Reinforced Concrete Pipe (RCP) under residential backyards and the railroad tracks on the northwest side of the creek. The inlet to the structure would start at a point 120-feet upstream of UPRR and go north along the creek bank to a point 60-feet downstream of Union Pacific Railroad (UPRR). See Appendix E (Flood Protection - Project Alternatives Description) for more details.

Operation and Maintenance

Operation and maintenance of the RCP would be minimal. The RCP would be designed to have adequate slope for sediment control.

Costs

Capital cost for this alternative alternative would be approximately $4.4 million.

Annual maintenance cost for debris clearing from inlet would be approximately $5,500.

See Appendix C for costs details.

ALT 4B: UPRR Bridge Replacement

Description

The existing 6-foot high by 13-foot wide (average width) UPRR crossing consists of a U-frame concrete channel covered by an old railroad clear span bridge made out of large heavily treated wooden beams. The 35-foot long channel opening under the existing UPRR bridge varies in width from 14.5 feet on the upstream face to 11.5 feet at the downstream face. This alternative consists of replacing the existing wooden bridge with a 7-foot by 12-foot (uniform height and width) Bridge Replacement between approximately STA 548+28 to STA 548+63.

This proposed alternative would prevent flooding upstream of the UPRR existing bridge during the 1% storm. See Appendix E (Flood Protection - Project Alternatives Description) for more details.

Operation and Maintenance

Operation and maintenance activities for the Bridge Replacement would be similar to the existing bridge. The Bridge Replacement would be designed to have adequate slope for sediment transport.

Costs

Capital cost for this alternative would be approximately $1.0 million.

Annual maintenance cost for debris clearing from inlet would be approximately $5,500.

See Appendix C for costs details.

ALT 4C: Floodwall

Description

This alternative consists of the installation of floodwalls up to 7.5 feet high along the 610-650 feet of channel immediately upstream of the UPRR on both banks. The existing UPRR bridge would remain the same with pressure flow under the upstream end. See Appendix E for (Flood Protection - Project Alternatives Description) more details.

Operation and Maintenance

O&M typical maintenance activities in this area would be expected to continue at the same level if this alternative is implemented. Typical maintenance activities include trash and debris removal, vegetation (overgrowth) removal and sediment removal. Graffiti problems and associated additional maintenance work may increase due to the presence of these large concrete walls.

Costs

Capital cost for this alternative would be approximately $0.8 million.

Annual maintenance cost for trash and debris removal, vegetation (overgrowth) removal and graffiti control would be approximately $10,500.

See Appendix C for costs details.

E. ALTERNATIVE RANKING METHODOLOGY

Natural Flood Protection (NFP) Board Policy

The District Board of Directors has adopted an ends policy that requires “natural flood protection” to be the method the District uses to provide flood protection to the citizens of the County. Ends Policy 2.2.1 states: “There is natural flood protection that balances environmental quality, community benefit and protection from creek flooding in a cost effective manner. In providing flood protection, balance the following multiple objectives:

2.2.1.1. Homes, schools, businesses, and transportation networks are protected from flooding and erosion.

2.2.1.2. Ecological functions and processes are supported.

2.2.1.3. Physical stream functions and processes are integrated.

2.2.1.4. Maintenance requirements.

2.2.1.5. Projects are integrated within the watershed as a whole.

2.2.1.6. The quality and availability of water is protected.

2.2.1.7. Cooperation with local agencies achieves mutually beneficial goals.

2.2.1.8. Community benefits beyond flood protection.

2.2.1.9. Life-cycle costs are minimized.”

To comply with this ends policy, a District Natural Flood Protection (NFP) procedure was developed. This report includes the NFP procedurAlt 1C, by which the feasible alternatives are rated and compared. District staff and consultants determined the NFP ranking based on multidisciplinary considerations including engineering and environmental planning.

Summary of the NFP Procedure

As required by the ends policy, the procedure balances the nine NFP objectives. Various criteria were developed to help rate each objective. These criteria were:

Objective 1: provide protection from flood damage

Criterion 1: safety – protection of public safety if conditions exceed design assumptions
Criterion 2: economic protection – protection from damage due to floodwaters, erosion or sediment
Criterion 3: durability – future effort required to maintain design level of protection
Criterion 4: resiliency – adaptability to future changes
Criterion 5: local drainage – support of local storm drain systems
Criterion 6: time to implementation – how quickly flood protection alternatives could become effective

Objective 2: support ecological functions and processes

Criterion 1: local habitat goals – ability to meet habitat goals as defined from examining the watershed as a whole
Criterion 2: habitat provided – quality of habitat provided by alternative
Criterion 3: sustainability of habitat – intensity of future action required to maintain design habitat quality
Criterion 4: connectivity of habitat – integration of habitat alternatives into surrounding landscape

Objective 3: physical stream functions and processes

Criterion 1: floodplain – inclusion of appropriately sized floodplain
Criterion 2: active channel – appropriateness of size and configuration of active channel
Criterion 3: stable side slopes – stability of side slopes
Criterion 4: transitions – stability of channel's integration with upstream and downstream reaches

Objective 4: minimize maintenance requirements

Criterion 1: structural features – maintenance associated with structural features
Criterion 2: natural processes – maintenance associated with vegetation, erosion and sediment
Criterion 3: urban flows – maintenance resulting from small storms and outfall flows
Criterion 4: access – incorporation of adequate access for maintenance crews and equipment

Objective 5: integrate within watershed

Criterion 1: meets watershed goals – ability to meet watershed goals as defined in a process that examines the watershed as a whole

Objective 6: protect the quality and availability of water

Criterion 1: water availability – impact on groundwater recharge

Criterion 2: in stream water quality – water quality protected through vegetation and in stream hydraulic complexity
Criterion 3: off stream water management – ability to enhance water supply and quality and reduce peak flows through local retention of rainfall
Criterion 4: flow regime – ability to maintain geomorphically and biologically appropriate range of flows

Objective 7: cooperate with other local agencies to achieve mutually beneficial goals

Criterion 1: mutual local goals – ability to achieve project-specific goals and objectives developed jointly by the District and local agencies
*Criterion 2: supports general plan – ability to support goals and policies as stated in general plans of partner agencie*s

Objective 8: community benefits beyond flood protection

Criterion 1: community safety – overall safety for appropriate access and recreation
Criterion 2: recreation – quality of recreation experience provided by alternative
Criterion 3: aesthetics – quality of aesthetic form provided by alternative
Criterion 4: social and cultural benefits – opportunity to provide community involvement
Criterion 5: local economic effects – potential effect on property values and/or local business climate
Criterion 6: open space – inclusion of open space into alternative
Criterion 7: community support – alternative reflects community developed objectives and ideas

Objective 9: minimize life-cycle costs

Criterion 1: net present value of lifetime costs

Some of the criteria required comparative ratings between the alternatives (for example, which alternative has the least or the most cost) while others were stand-alone ratings (for example, how well does the alternative meet community goals). Each alternative was rated as to how well it accomplished each criterion. A scoring system assigned various weights to the criteria and calculated the objective score (see Appendix D for NFP rating details and results.) for each Alternative. Appendix D also shows a comparison of how well the alternatives are rated on each of the nine NFP objectives.

Community input will be used to determine whether some NFP objectives should be considered more important than others. Specific to this project, the Watershed Manager has assigned a relative importance to each objective (High, Medium, Low or Not Applicable). The nine natural flood protection objectives with their relative importance ratings are summarized in Table ALT 1A:

NFP Objective	**Relative Weight**
Provide additional protection from flood damage beyond project objectives	M
Support ecological functions and processes	H
Integrate physical stream functions and processes	H
Minimize maintenance requirements	H
Integrate within the context of the watershed	L
Protect the quality and availability of water	M
Cooperate with other agencies to achieve mutually beneficial goals	M
Maximize community benefits beyond flood protection	L
Minimize life cycle costs	M

Table E-1: Summary of NFP Objectives

Environmental Impacts

The District's Natural Flood Protection Evaluation Guideline objectives included an evaluation of environmental impacts of project alternatives.

NFP Rating of Feasible Alternatives

The staff-recommended alternative for flood protection was selected based on a comparison of the NFP ratings of all the alternatives at each of the two flooding sites (Site #3 & #4) in the project. See the following tables for the summary of the NFP ratings for each site.

SITE #3 (Prospect to Saratoga-Sunnyvale Tunnel)

District Ends Policy 2.2.1 (Natural Flood Protection):	**Objective Weight Rank:**	Underground RCB* bypass **ALT 3A**	Additional RCB* / new double RCB* **ALT 3B**	Floodwall **ALT 3C**	Swale detention basin **ALT 3D**	Swale detention and tunnel modification **ALT 3E**
1. Provide additional protection from flood damage	M	◒	◒	◒	◒	◒
2. Support ecological functions and processes	H	◔	◔	○	◔	◔
3. Integrate physical stream functions and processes	H	○	○	○	◒	◔
4. Minimize maintenance requirements	H	◒	◒	○	◔	◒
5. Integrate within the context of the watershed	L	◔	◔	◔	◒	◕
6. Protect the quality and availability of water	M	◒	◒	◔	◒	◒
7. Cooperate with other local agencies to achieve mutual goals	M	◔	◔	◔	◔	◔
8. Maximize community benefits beyond flood protection	L	◔	◔	○	◔	◔
9. Minimize life-cycle costs	M	○	○	◕	◒	◒

Ratings Key:

Outstanding:	●	Fair:	◔
Very Good:	◕	Poor:	○
Adequate:	◒	Unacceptable:	X

* RCB = Reinforced concrete box

SITE #4 (UPRR)

			Underground RCP* bypass	UPRR Bridge Replacement	Floodwall
District Ends Policy 2.2.1 (Natural Flood Protection):	**Objective Weight Rank:**		**ALT 4A**	**ALT 4B**	**ALT 4C**
1. Provide protection from flood damage	M		◒	◒	◒
2. Support ecological functions and processes	H		○	◔	○
3. Integrate physical stream functions and processes	H		○	○	○
4. Minimize maintenance requirements	H		◔	◔	◔
5. Integrate within the context of the watershed	L		○	◒	◔
6. Protect the quality and availability of water	M		◒	◒	◔
7. Cooperate with other local agencies to achieve mutual goals	M		◔	◔	◔
8. Maximize community benefits beyond flood protection	L		◔	◔	◔
9. Minimize life-cycle costs	M		○	○	◕

Ratings Key:

Outstanding: ●
Very Good: ◕
Adequate: ◒
Fair: ◔
Poor: ○
Unacceptable: **X**

* RCP = Reinforced concrete pipe

F. EROSION SITE REPAIR WORK

This section summarizes the following topics with regard to bank erosion present on Calabazas Creek in the reach between Miller Avenue and Comer Drive:

- Causes of bank erosion
- Erosion repair site selection methodology
- Erosion repair criteria and methods
- Proposed erosion repair work

The subject reach was inspected by staff from Hydraulic Engineering Unit, Hydrology Engineering Unit, Geotechnical Engineering Unit, and Watershed Field Operation Unit in several trips between May 2005 and October 2007. The findings, analysis and proposed bank protection work are described below.

Causes of Calabazas Bank Erosion

Existing creek geometry

All of Calabazas Creek within the project limits (Miller Avenue and Comer Drive) consist of natural channel banks from about 6 to 20 feet high. The channel is typically incised with a trapezoidal cross-section, having more capacity than the 1% flood flow, except for a few isolated locations. The banks are typically steep. Bank slopes steeper than ½H : 1V are common throughout the project limits. Vegetation covers most of the bank surfaces, with grasses, vines and shrubs in lower levels and woody trees at higher places. Where the density of vegetation on the bank slope is very low, soil loss is observed. Most erosion occurs at the outside bend of channel curves. Some slope failures exist. In general, the channel invert through the project reach appears to have reached dynamic equilibrium. This is evidenced by the stable invert elevations next to concrete slabs observed over the last several years. The soil banks present throughout this portion of Calabazas Creek consist of light brown sandy to clayey silt material containing smaller diameter gravel. The causes of erosion are analyzed below.

Toe erosion

A major cause of the observed bank erosion is toe erosion. There are two different types of observed toe erosion within the project limits. One is the result of previous channel bed degradation. This happens in the reach between Comer Dam and UPRR (see Figure F-1 on page 29). The degradation occurred in the first 15 years after Comer Dam was built. Loss of the channel bottom has caused failure of some storm drain outlet structures such as the drain outlet at Sta 438+75. Failure of sacked concrete structure is found at Sta. 556+70. Photographs of these representative sites are presented in Appendix G. The other type of toe erosion occurs at the outside bends, where secondary flow and higher flow velocity along the outside bank erodes more soil and eats into the bank. This is commonly observed along curved sections of the reach. Some erosion is more severe than others. Some has exposed tree roots and threatens to topple the trees above it. Sta. 497+87 and 498+50 are the typical examples.

Slope instability

The other cause of erosion is structural failure of bank slopes. Geotechnical stability criteria classify soil slopes steeper than 1½H:1V as unstable for the type of soil in the project reach. The banks on this creek are mostly steeper than 1H:1V. It may have a potential to fail if there are no tree roots to strengthen the soil structure, no vegetation cover to protect the soil from direct flow shear, and insufficient drains to reduce soil pore pressure. The banks were stable over the years because trees and vegetation have helped stabilize the slopes. At locations where failure has occurred, the failures were the result of several physical phenomena:

- Higher shear stress on the channel bottom occurs during storm flows. Because the channel is incised, the bottom shear stress keeps increasing with higher water level.
- The higher shear stress removes the soils from the bottom and toes, thereby undercutting the bank slope.
- If bank soil stays saturated, it loses its strength and the added weight of water and the loss of support from the bottom may be sufficient to cause the slope to fail.

When slope failure occurs, large masses or blocks of soil will fall from the banks. Slope failures create a pockmark appearance on bank slope, generally leaving near vertical side slopes. Sta. 559+30 and Sta. 579+00 are the good examples of the structural failure of bank slopes.

Erosion Repair Site Selection Methodology

In May and December 2005, field inspections identified 84 erosion sites in the project reach. The sites were classified based on the severity of erosion. Three classes of erosion severity were determined:

- Major – active ongoing erosion threatening structures or large trees
- Minor – not severely eroded, but having potential to become major erosion
- Noted Only – not severely eroded and not expected to become a major erosion site in the near future.

Of the 84 sites identified, 25 were classified as "major," 34 were classified as "minor," and 25 were classified as "noted only." Figure F-1 illustrates areas of all the major erosion sites and creek access points. These 25 major sites are shown in the photographs and summarized in tables in Appendix G.

The remaining 59 erosion sites (34 "minor" and 25 "noted only" sites) will be monitored by District maintenance personnel to track further erosion in the future. These 59 sites are also summarized in the tables found in Appendix F. If needed, corrective action will be performed in accordance with the Stream Maintenance Program.

Following the site analyses, the erosion-protection scope of this project was set to cover the 25 major erosion sites to control cost. Monitoring and maintenance in the future will ensure continued creek stability and provide good aquatic habitat. Biotechnical methods utilizing primarily natural materials were selected for the recommended bank protection design.

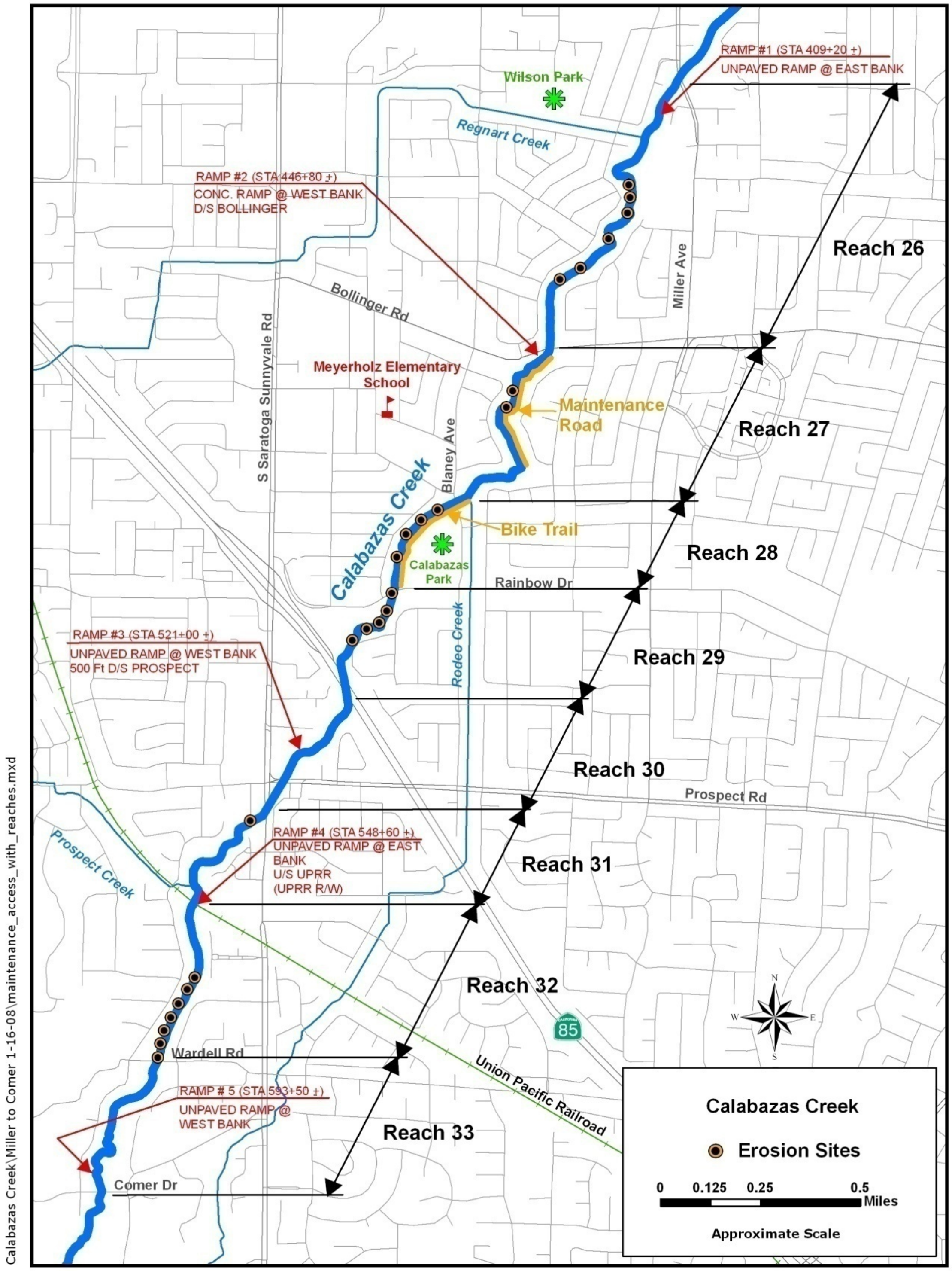


Figure F-1: Major Erosion Sites Map

Erosion Repair Criteria and Methods

The criteria and considerations used to select erosion protection methods include the following:

- Minimize encroachment into the existing active flow area of the channel
- Meet stability requirements of the local channel geometry and soil characteristics
- Minimize habitat and environmental impacts
- Consider natural materials consistent with the local environment
- Be cost effective
- Allow revegetation
- Minimize maintenance and operational cost

The methods available for erosion repair are listed below. Some of the methods are restricted to certain site conditions such as mild slope, slower flow velocity, having a bankfull-and-floodplain channel geometry, etc. These restrictions are not specifically identified below, but are considered in selecting the repair method.

I. Live Construction (traditional use of grass or live plant cuttings)

  A. Cuttings
  B. Transplants
  C. Live Staking
  D. Direct Seeding

II. Mixed Construction (methods using organic combined with inert materials)

  A. Soil Bioengineering
    1. Contour Wattling
    2. Brush Layering
    3. Bank Surface Matting

B. Biotechnical Slope Protection
    1. Boulder Toe Protection covered with vegetation
    2. Root Wad with Footer
    3. Soil Cellular Confinement System (GEOCELL)
    4. Rock Revetment
    5. Log Crib Wall
    6. Log Toe Protection covered with vegetation
    7. Combination with live construction
    8. Log Mattress Protection covered with vegetation

Proposed Erosion Repair Work

Bioengineering repair methods were selected because those methods can enhance habitat development, site protection, water quality improvement and aesthetics to meet the project goals. The bioengineering streambank stabilization work considers the use of vegetation in combination of structural elements which are typically natural materials such as wood logs and rock boulders. It allows the structure to fit into each eroded site, and allows proper transition from the upstream, downstream and cross-stream to be properly considered. However, the evaluation of detailed biological components with regard to their ability to maximize their channel enhancement potential isn't fully completed in planning phase. Some areas where construction and costs need to be considered in more detail will need further site-specific analysis prior to completion of the design plans.

The channel in the project reach has been modeled to study sediment transport through the reach. The results show that the current invert profile and channel geometry is stable, confirming field observations described earlier. This conclusion allows the repair method to focus on restoring channel geometry without concerns of future degradation or aggradation. The method selected for each of the 25 sites is shown in Table F-1. Selection of the methods proposed was dependant on various factors such as toe condition, bank slope and density of vegetation. Further discussion on how the 25 major erosion sites were selected is found in Appendix G.

Station	Site Description	Erosion Repair Method
424+70	East bank erosion	Log Mattress Bank Protection with Vegetation
426+05	East bank erosion	Log Mattress Bank Protection with Vegetation
426+46	East bank erosion	Log Mattress Bank Protection with Vegetation
428+65	East bank erosion	Log Mattress Bank Protection with Vegetation
438+75	West bank storm drain outfall unsupported.	Boulder Toe Protection with Vegetation
440+40	West bank erosion	Log Mattress Bank Protection with Vegetation
456+85	East bank toe erosion & exposed tree roots	Log Mattress Bank Protection with Vegetation
457+25	Toe erosion on east bank	Log Mattress Bank Protection with Vegetation
481+50	West bank toe erosion & exposed tree roots	Log Mattress Bank Protection with Vegetation
484+37	East bank toe erosion & exposed tree roots	Log Mattress Bank Protection with Vegetation
484+63	East bank toe erosion & exposed tree roots	Log Mattress Bank Protection with Vegetation
488+71	West bank toe erosion & exposed tree roots	Log Mattress Bank Protection with Vegetation
494+58	Severe scour on east bank	Boulder Toe Protection with Vegetation
496+80	West bank toe erosion & exposed tree roots	Boulder Toe Protection with Vegetation
497+87	East bank toe erosion & exposed tree roots	Boulder Toe Protection with Vegetation
498+26	East bank toe erosion & exposed tree roots	Boulder Toe Protection with Vegetation
498+50	East bank toe erosion & exposed tree roots	Boulder Toe Protection with Vegetation
537+00	Severe erosion on east bank	Log Mattress Bank Protection with Vegetation
556+70	Severe scour behind sacked concrete slope protection on east bank	Boulder Toe Protection with Vegetation
559+30	Severe west bank erosion	Boulder Toe Protection with Vegetation
563+04	Severe east bank erosion	Boulder Toe Protection with Vegetation
565+98	East bank toe erosion & exposed tree roots	Log Mattress Bank Protection with Vegetation
566+20	Severe erosion on east bank	Log Mattress Bank Protection with Vegetation
568+28	West bank storm drain outfall unsupported.	Boulder Toe Protection with Vegetation
579+00	Severe erosion on west bank	Boulder Toe Protection with Vegetation

Table F-1: Summary of Proposed Erosion Repair Work

G. CHANNEL RESTORATION OPPORTUNITIES

Comer Debris Basin Geomorphic Design Modification

The Comer Debris Basin is located on Calabazas Creek just downstream of Comer Drive Bridge. Comer Dam was constructed in 1973. This dam, shown in Figure G-1 below, was constructed so that the bottom 6 feet of the downstream face of the dam was below grade.

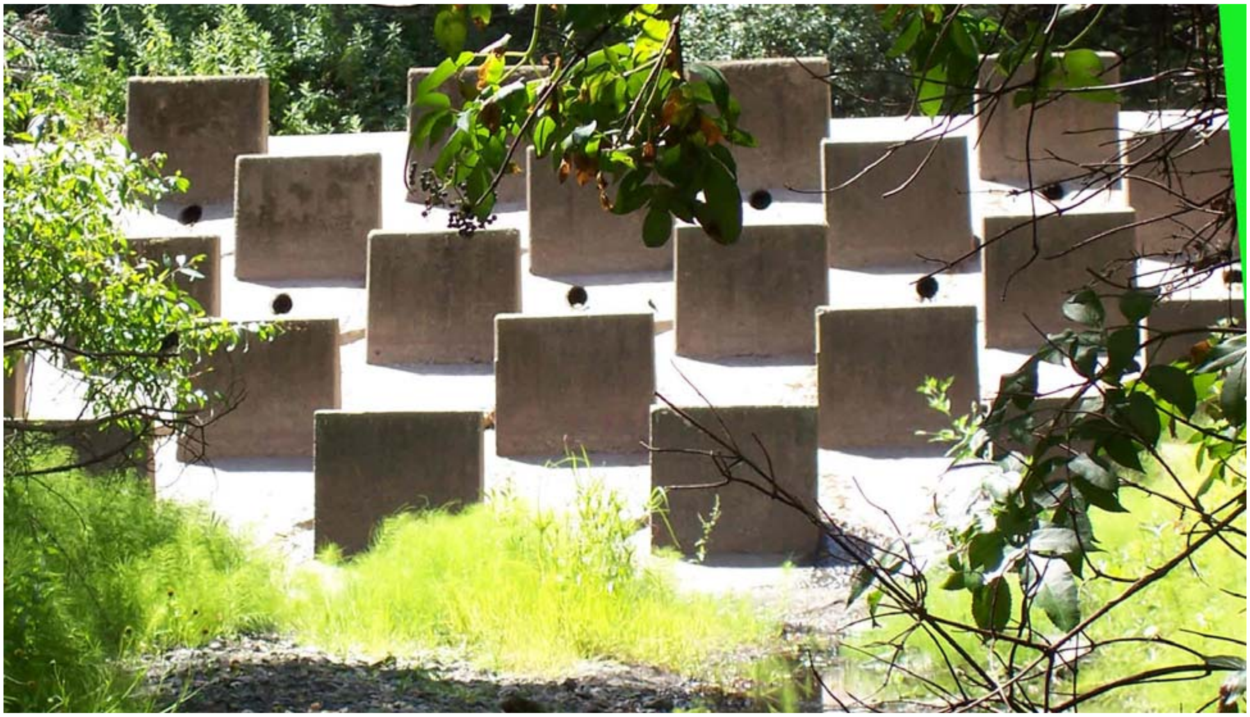


Figure G-1: Comer Dam

Between 1973 and 1992, the area upstream of the dam and under Comer Drive Bridge was routinely excavated and naturally refilled from the high sediment loads carried by the creek. The reach downstream of the dam eroded away until the entire depth of the dam was exposed. After 1992, when the District halted its maintenance program, the channel in the vicinity of Comer Dam reached equilibrium. Although stable, the reach of creek around Comer Drive Bridge has decreased the depth of the opening under the bridge from about 10 feet to about 4 feet[4], which has raised community concerns about bridge overtopping during large storm events. In addition, the Dam is not aesthetically pleasing and provides poor habitat for vegetation.

In response to these concerns and others, the District has identified three main feasible alternatives for replacing the Dam. See Appendix I for more details.

In all three feasible alternatives identified, the invert is raised or lowered to address the present sediment buildup in the Basin. See Figure G-2 below for the typical sections.

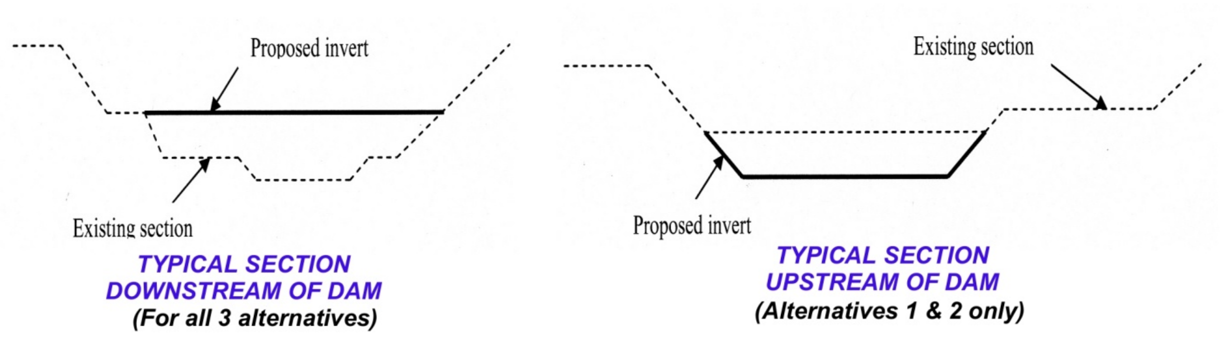


Figure G-2: Channel Typical Sections

Alternative 1

Alternative 1 involves complete removal of the Comer Dam, including its wing walls. The channel would be excavated to have a consistent and stable slope. This alternative would improve flood protection at the Comer Drive Bridge and would provide improved aquatic riverine habitat by removing the Dam obstruction[4]. Alternative 1 is illustrated below in Figure G-3.

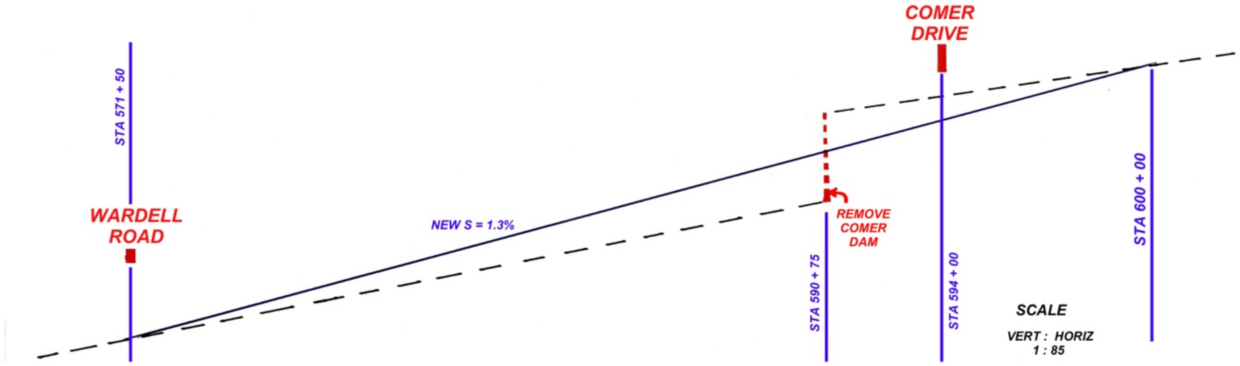


Figure G-3: Comer Alt #1 Profile

Alternative 1 would have about a 1.3% slope, and will also provide 8 feet of clearance beneath Comer Drive Bridge to provide the needed 100-year flood protection. Under this alternative, the impact area totals about 2700 ft, spanning from 600 feet upstream of Comer Drive Bridge downstream to a point 170 ft upstream of Wardell Drive. Construction of Alternative 1 would include significant amounts of excavation upstream of the dam, and significant amounts of fill downstream of the dam. The earthwork would need to include replacement of the existing armor layer on top of the bed to ensure that invert roughness in the project reach would match the invert roughness both upstream and downstream. The proposed channel cross sectional shapes within the work area would be based on stable cross sections located upstream of the existing debris basin, which are stable in the natural, undisturbed portions of the existing channel.

Alternative 2

Alternative 2 would involve removing the dam and wing walls in their entirety, and replacing them with a series of small drop structures. In addition to potentially providing similarly improved aquatic habitat and improved flood protection as Alternative 1, it also would provide the aesthetics of small waterfalls and some channel invert protection. Alternative 2 is illustrated below in Figure G-4.

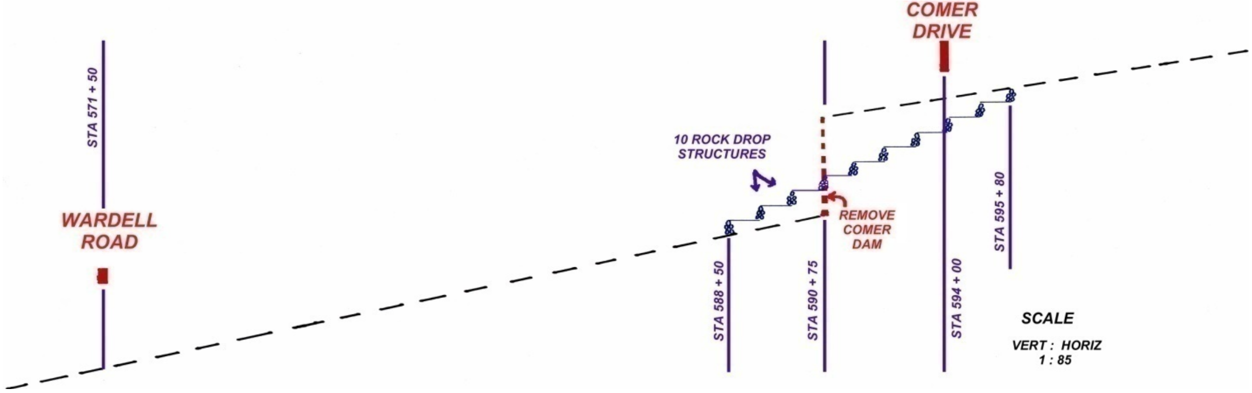


Figure G-4: Comer Alt #2 Profile

The feasible design of Alternative 2 includes 1) a channel realignment to straighten the channel slightly in the vicinity of Comer Dam, and 2) construction of 10 drop structures with drop heights ranging from 0.8 – 1.2 feet tall and drop lengths ranging from 60 – 170 feet. This alternative has an impact area of about 750 feet of channel length, extending both downstream and upstream of the existing debris dam. The drops would be placed away from bends in the creek's path. The design slope between drops is approximately 1%. The drops themselves would be constructed of rock. Downstream of each drop, a pool is constructed by covering the 15 feet immediately downstream of each drop with rock. The channel bed between drop structures would be constructed with an armoring layer of small gravel similar to that which exists upstream of the dam, yielding similar roughness to the channel bottom. The cross-sectional shape of the channel would be based on that of stable channel reaches upstream, as for Alternative 1.

Alternative 3

Alternative 3, the least expensive of the three alternatives, involves partial removal of the dam. The main benefit from construction of Alternative 3 would be the improved flood protection at Comer Drive Bridge. Secondary benefits would include a generally improved environment for the establishment of vegetation and for aquatic life. Alternative 3 is illustrated below in Figure G-5.

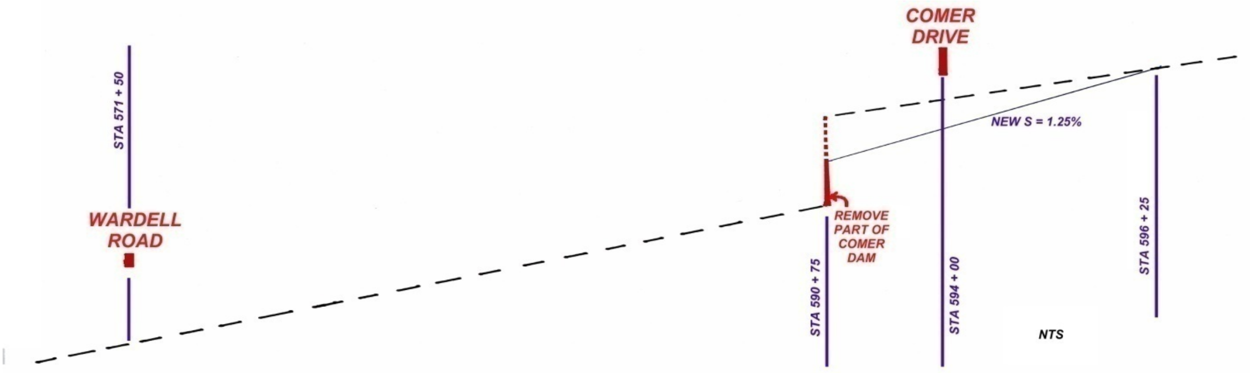


Figure G-5: Comer Alter #3 Profile

Alternative 3 has an impact area of about 500 linear feet, which is much smaller than the impact areas for the other two alternatives. The top 6.4 feet of the dam would be removed, with care to ensure that the structure is stable. A constant slope of 1.25% would be extended from the dam to conform to the existing invert approximately 175 feet upstream of Comer Drive bridge. The design channel cross section shape would be geomorphic and based on stable channel cross sections from natural portions of the creek measured further upstream. The low flow channel would need to be covered with an armoring layer similar to that of the reach of creek upstream.

Comer Alternative Evaluation

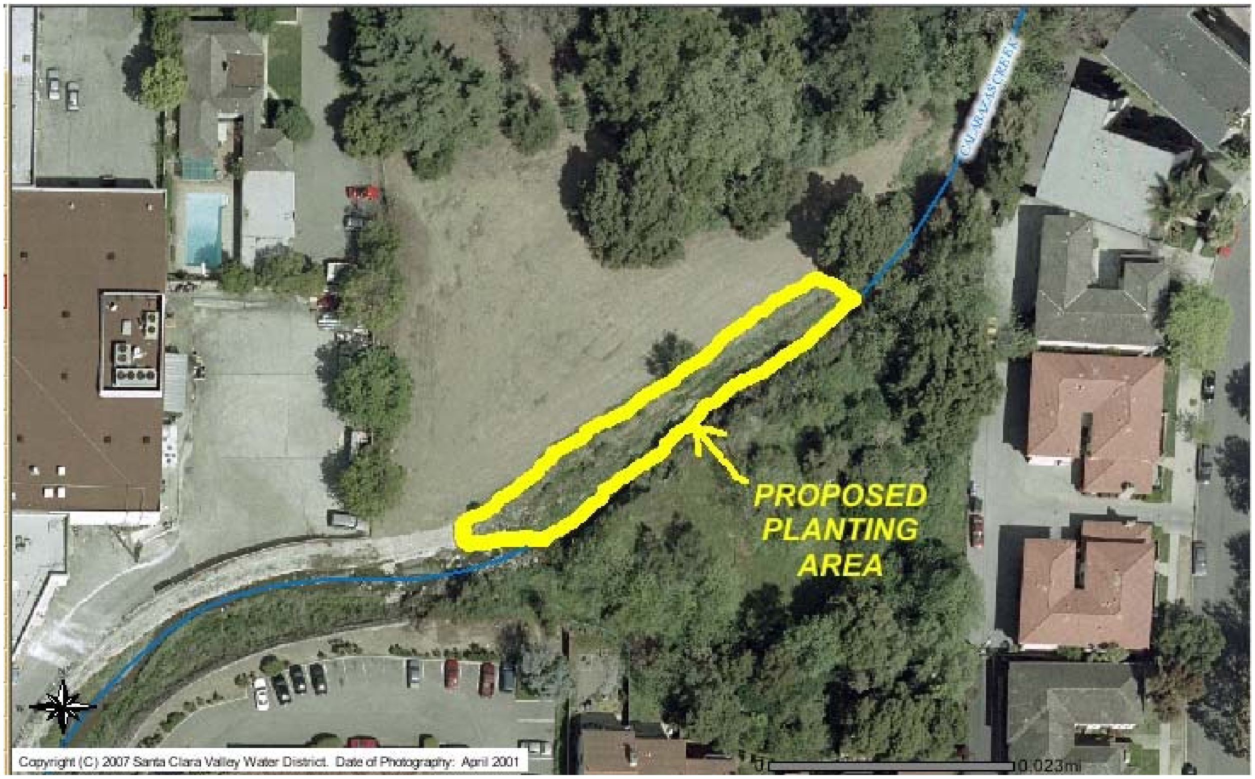
From an invert stability perspective, Alternatives 2 and 3 have been shown to be equally stable according to this steady-state SAM (Sediment Analysis Methods) analysis. See the summary recommendations in Appendix 1 for a fuller discussion.

From an impact area perspective, Alternative 1 would have the largest impact area, followed by Alternatives 2 and 3. Alternative 2 has an impact area which is only about 250 feet longer than Alternative 3.

From initially perceived environmental and aesthetic perspectives, Alternative 2 is preferred. Alternative 2 would entirely eliminate Comer Debis Basin and Comer Dam and impact a shorter segment of channel than Alternative 1. In light of the environmentally sensitive nature of this project, Alternative 2 is the staff-recommended alternative at this time. Construction costs for Alternative 2 are approximately $1,100,000 and some additional right of way would be needed from adjacent property owners. Riparian impacts may occur and may require mitigation.

Revegetation Enhancement

The District holds in fee title about 1 acre of land on the northwest side of Calabazas Creek about 500 feet downstream of Prospect Road. This enhancement entails the vegetation of approximately 3,800 square feet of vegetation in the area shown below.



Copyright (C) 2007 Santa Clara Valley Water District. Date of Photography: April 2001

Figure G-8: Plan view of Proposed Area

The area circled in the diagram above currently has low value shrubs. The proposal is to plant the toe of the creek (about 1,000 square feet) with willows. Along the upper banks, the remaining 2,800 square feet could be planted with buckeye, coast live oak and elderberrys. Cost would be approximately $50,000 for initial planting and no additional right of way would be needed.

Calabazas Park Meander Restoration

Historically, Calabazas Creek meandered through the Calabazas Park area between Blaney Avenue and Rainbow Drive. The channel was straightened several decades ago to accommodate single family homes located on the west side of Calabazas Creek. This alternative proposes the re-establishment of the creek through part of its historic alignment. Figures G-6 and G-7 below show the plan view and cross section respectively for this proposal.

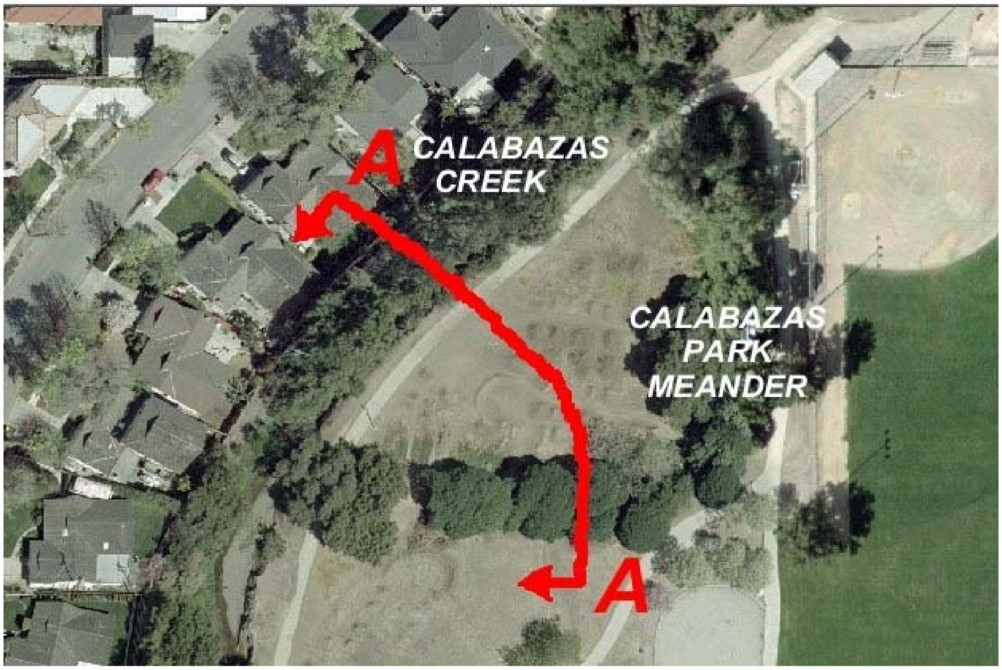


Figure G-6: Aerial view of Calabazas Park Meander

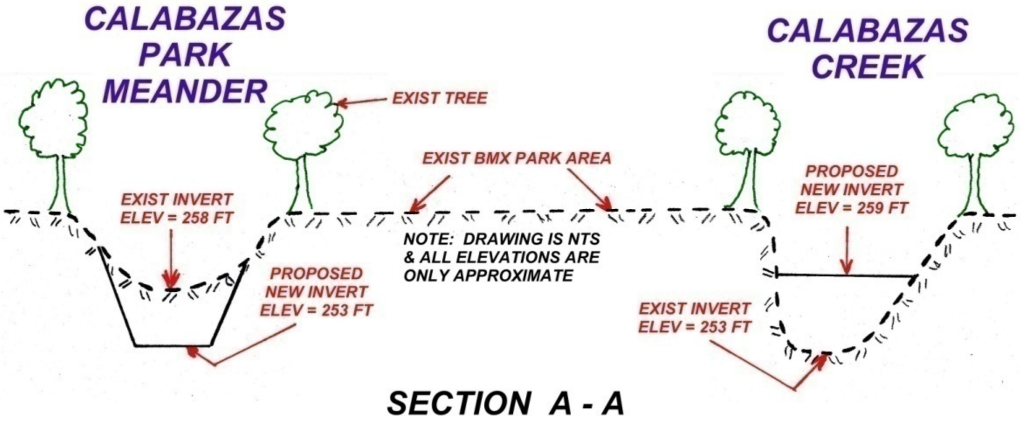

CALABAZAS PARK MEANDER
EXIST TREE
CALABAZAS CREEK
EXIST BMX PARK AREA
EXIST INVERT ELEV = 258 FT
PROPOSED NEW INVERT ELEV = 259 FT
NOTE: DRAWING IS NTS & ALL ELEVATIONS ARE ONLY APPROXIMATE
PROPOSED NEW INVERT ELEV = 253 FT
EXIST INVERT ELEV = 253 FT
SECTION A - A

Figure G-7: Cross section of Calabazas Park Meander

Implementation of this alternative would have many benefits including the following:
The creek would be routed through Calabazas Park instead of along the park edge, providing this public park with a live stream running through it. The total creek length between Blaney Avenue and Rainbow Drive would be extended by more than 200 feet, enhancing aquatic life. Erosion would be reduced with the flatter channel invert slopes, reducing maintenance costs.

Impacts include re-routing of a sidewalk trail, building a bridge to access the BMX area, potential damage to existing trees. Riparian impacts may require mitigation.

Implementation of this alternative would be consistent with the project objectives of channel enhancements, erosion control and stream restoration. See Appendix J for a summary of the technical components of this alternative.

Cost would be approximately $400,000 for construction. Additional right of way would be needed from the City of San Jose.

H. PUBLIC INPUT

Public Meetings

The project team conducted three public meetings on July 24, August 2 and August 25 in 2005 to present the Conceptual Alternatives to the public. At these meetings, a few attendees expressed skepticism that the one-percent flood would be a problem that needed to be addressed. However, a large cross section of the public expressed concern about on-going creek erosion. The proposed project alternatives are located in an environmentally-sensitive community. The community has stated that erosion protection is extremely important. However, the community wants erosion addressed without compromising the natural beauty of the creek.

Future Public Outreach

Comments on the staff-recommended alternative will be the subject of the next public meetings. The project team has incorporated comments and many of the recommendations from the public that were collected in the last public meetings.

I. CONCLUSION

Overview

The Santa Clara Valley Water District (District) constructed flood protection projects on Calabazas Creek from San Francisco Bay to Miller Avenue in the 1990's. The proposed project would bring flood protection, erosion control, biological enhancements and recreational opportunities the cities of San Jose, Cupertino and Saratoga along Calabazas Creek between Miller Avenue and Comer Drive. This project would protect 2,483 homes, businesses, and schools from the one-percent flood, preventing flood damages in excess of $30.9 million (Clean Safe Creek and Natural Flood Protection on July 25,2000).

The District produced a Problem Definition / Refined Objects Report between June, 2004 and July, 2005. Two public meetings were held between July and August of 2005 to convey the existing creek conditions to the general public. A Conceptual Alternatives Report was produced in January, 2006. The District returned to the general public to convey the Conceptual Alternatives in two public meetings held between January and February of 2007.

Recurrent flooding during a 1% storm event along Calabazas Creek was identified at four locations during initial 2005 analysis. These four flooding sites are summarized below:

Site #1: Calabazas Park between Rainbow Drive and Blaney Avenue

Site #2: Residential area downstream of HWY 85

Site #3: Business parking lot upstream of Saratoga-Sunnyvale Road.

Site #4: Residential area upstream of the Union Pacific Rail Road, UPRR.

The City of San Jose began construction of a BMX Park adjacent to Calabazas Creek at Site #1 in December, 2006. Grading required to build the BMX Park raised the adjacent Calabazas Creek banks high enough to eliminate flooding at Site #1. Therefore, staff does not recommend any District work to address flooding at Site #1.

Flooding at Site #2 affects one private swimming pool. The financial impacts associated with the flooding of this pool would be very low. Therefore, staff does not recommend any District work to address flooding at Site #2.

Staff Recommended Flood Protection Work

Staff analyzed a 8 different flood control alternatives at the various flooding sites. Since Sites #3 and #4 are the only ones carried to the recommended alternatives stage (see overview above), only these two sites were evaluated using the NFP criteria.

Staff recommends that flooding be addressed at Site #3 by Alternative 3E or “ALT 3E” which is described in detail in Appendix E of this Report. In summary, ALT 3E entails a partial replacement of the existing Saratoga-Sunnyvale tunnel and a modification of the swale upstream of the tunnel to create a storm water detention basin during peak flows.

Staff recommends that flooding be addressed at Site #4 by Alternative 4B or “ALT 4B” which is described in detail in Appendix E of this Report. In summary, ALT 4B entails the full replacement of the Union Pacific Railroad (UPRR) Bridge. District negotiations with the UPRR for this work would be completed in the preliminary design stage for this project.

The combined total estimated cost of the two recommended flood protection features is $4.7 million dollars.

Staff Recommended Erosion Control Work

Extensive creek bank erosion jeopardizes residential and public lands adjacent to the creek. The following table lists the stations of the twenty five major erosion sites have been identified for repair as part of this project.

424+70
426+05
426+46
428+65
438+75
440+40
456+85
457+25
481+50
484+37
484+63
488+71
494+58
496+80
497+87
498+26
498+50
537+00
556+70
559+30
563+04
565+98
566+20
568+28
579+00

See Appendix G for a complete description of these sites.

Staff recommends that the Stream Maintenance Program (SMP) regulatory permits be used for the construction of the proposed bank erosion repair along Calabazas Creek between Miller Avenue and Wardell Road. The actual bank repair plans would be included in the Calabazas Creek, Miller to Comer construction documents and performed by the Lower Peninsula/West Valley Watershed Field Operations Unit.

The total estimated cost of the staff recommended erosion control work is $2.8 million dollars.

Environmental Enhancement Opportunities for the Board consideration

Three environmental enhancement opportunities were identified during the planning process. All three of these enhancements are summarized below:

Comer Dam Modification

Comer Dam was built originally to address excess sediment in Calabazas Creek created by quarry work further upstream. After the quarry activities ceased, the value of Comer Dam diminished and the District discontinued Dam maintenance activities in 1992. Three different alternatives which would modify the Comer Dam have been analyzed in Appendix J of this Report. Staff recommends that Alternative 2 be presented to the Board for consideration, which entails the replacement of Comer Dam with a series of 10 cross channel rock stabilizers. This alternative would accommodate the movement of aquatic life and eliminate the ongoing maintenance costs of cleaning out the Debris Basin.

The total estimated cost of Comer Dam modification, Alternative 2, is $1.0 million dollars.

Calabazas Park Meander Restoration

The re-establishment of the abandoned historic creek alignment would enhance aquatic life, enhance the Calabazas Park environment and reduce erosion problems in the main channel. See Appendix J for further details.

The Calabazas Park Meander could potentially damage many existing heritage oak trees. Staff biologists have recommended further analysis of the site to determine the extent of possible adverse impacts of this enhancement before it is implemented.

The total estimated cost of Calabazas Park Meander Restoration is $400,000 dollars.

Revegetation Enhancement

The revegetation of approximately 3,800 square feet of Calabazas Creek downstream of Prospect Road would enhance aquatic life and enhance that area.

The total estimated cost of the revegetation is $50,000 dollars.

REFERENCES

1. Santa Clara Valley Water District's "Problem Definition / Refined Objectives Report" which was last updated in May, 2007.

2. Santa Clara Valley Water District's "Clean Safe Creek and Natural Flood Protection" report dated July 25, 2000.

3. Santa Clara Valley Water District's "Guidance on Alternative Evaluation for Selection for Natural Flood Protection Projects", Revision 1 dated August 25, 2005.

4. Kennedy/Jenks Consultants report entitled: "Comer Debris Basin Engineering Feasibility Study Final Report" published in April, 2002.